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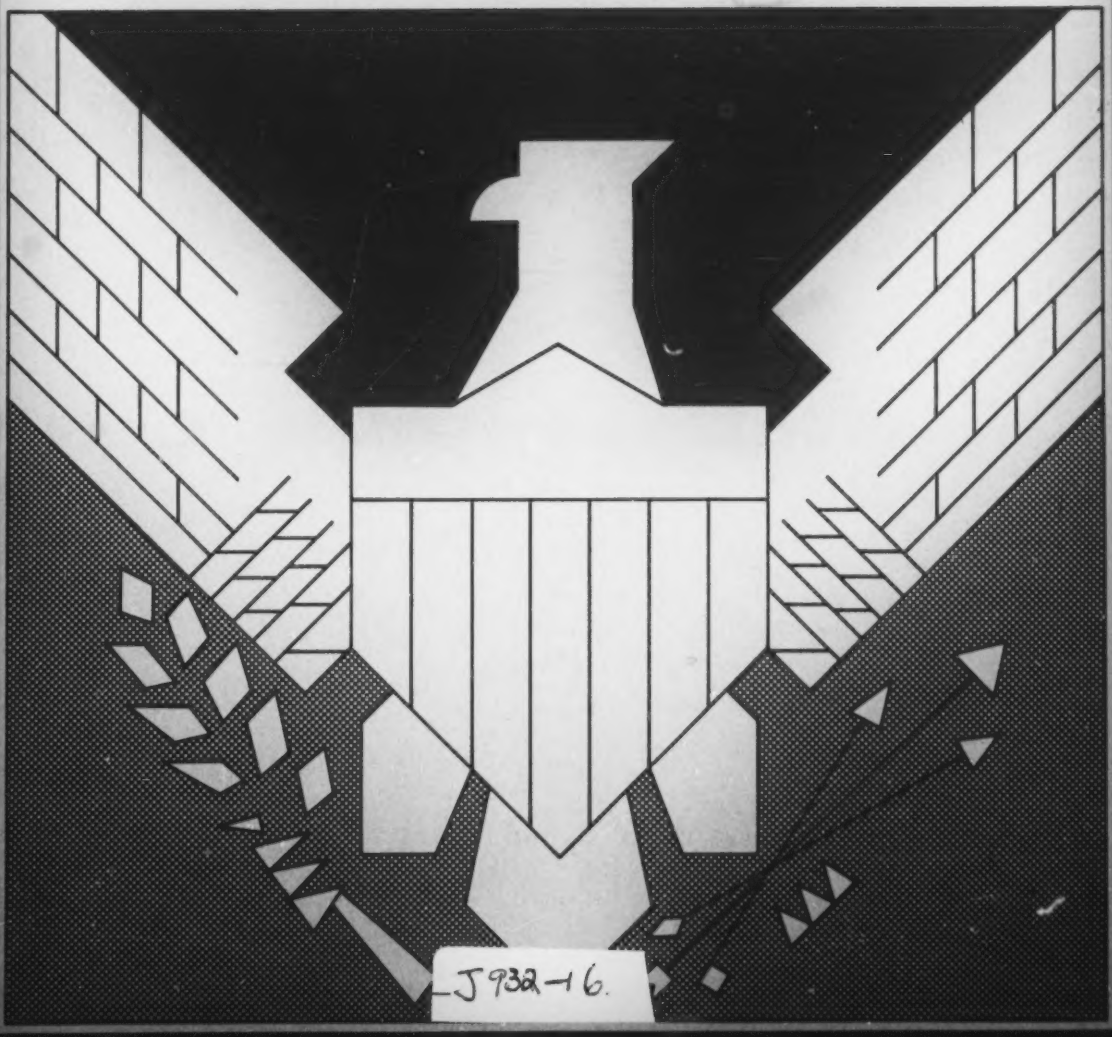
Issues and Options for the Navy's Combat Logistics Force



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CBO STUDY

ISSUES AND OPTIONS FOR THE NAVY'S COMBAT LOGISTICS FORCE

The Congress of the United States
Congressional Budget Office

NOTES

All years referred to in this report are fiscal years unless otherwise indicated.

All costs are expressed in fiscal year 1989 dollars of budget authority, using the Administration's February 1988 economic assumptions, unless otherwise noted.

PREFACE

The Navy's combat ships are resupplied regularly at sea by the ships of the Combat Logistics Force (CLF). To date, the Administration has requested, and the Congress has funded, an inventory of about 59 CLF ships, six ships short of the Navy's goal of 65. If all CLF ships in the Administration's most recent shipbuilding plan, which covers 1989 to 1992, are authorized by the Congress as proposed, then the Navy would field 64 CLF ships, only one ship short of its goal. However, the Administration is currently reviewing its shipbuilding plans to accommodate reduced defense spending, and, if history is a guide, authorization of some of the CLF ships in the current plan could be postponed beyond 1992. If this postponement occurs, shortages of CLF ships may persist. In a future war, these shortages could be critical, forcing the Navy to adjust tactics or the deployment of ships to accommodate deficiencies in logistics support.

This analysis by the Congressional Budget Office (CBO) addresses the Navy's inventory goals for the CLF and the effect that the Administration's shipbuilding plans will have on meeting those goals. The report also discusses alternative strategies for the procurement of CLF ships over the next four years. The study was requested by the Subcommittee on Seapower and Strategic and Critical Materials of the House Committee on Armed Services. In keeping with CBO's mandate to provide objective analysis, the study contains no recommendations.

Michael B. Berger of CBO's National Security Division prepared the study under the general supervision of Robert F. Hale and John D. Mayer, Jr.; William P. Myers of CBO's Budget Analysis Division provided detailed cost analysis, with the assistance of Ben J. Wolters. The author gratefully acknowledges the contributions of Wayne Glass of CBO's National Security Division and Philip C. Webre of CBO's Natural Resources Division. Amanda Balestrieri edited the manuscript. Rebecca J. Kees prepared early drafts of the report, and Nancy H. Brooks and Kathryn Quattrone prepared the final draft for publication.

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SUMMARY

Building the 600-ship Navy has been a key aspect of the Administration's program to improve conventional military forces. The Navy has grown from about 479 ships in 1981 to about 570 today and expects to grow to about 600 vessels in the 1990s. To support the expanded fleet, the Navy's logistics establishment may also have to grow. The ships of the Combat Logistics Force (CLF) are a critical part of the Navy's logistics system. The CLF resupplies Navy combat ships at sea with fuel, stores, and ammunition.

If the logistics force grows, however, there will be less money available to buy primary combat ships, such as cruisers, destroyers, and Marine transport ships. Relative to its own goals, the Navy is short of the most modern vessels in these categories. Moreover, decisions about what ships to buy must accommodate declines in total defense spending that may restrict funds for shipbuilding.

Thus, the Navy faces difficult trade-offs. Should purchases of CLF ships be pared back in order to maintain funding for primary combat ships? Such a reduction would risk degrading the capability of these combat ships because there might not be enough CLF ships to support them. Or are the CLF ships of sufficient priority to merit sustaining, or even increasing, planned purchases?

REPLENISHMENT OPERATIONS

During a war, the Navy would have to transport supplies from depots and factories in the United States to fighting ships at sea, which could be located thousands of miles away. It plans to do this in three steps.

First, commercial merchant ships will take on supplies at ports in the United States, and transport them to ports abroad that would serve as forward logistics bases. Next, at the forward base, the goods will be consolidated and loaded onto CLF "shuttle ships": oilers,

ammunition ships, and stores ships. The shuttle ships will transport the supplies to the fighting forces, escorted by a small contingent of combat ships. When they reach the fighting forces, the shuttle ships will transfer their loads to CLF "station ships"--fast combat support ships or fleet replenishment oilers--that will be accompanying the combat forces. In the third and final step, the station ships will transfer the supplies to the fighting ships.

There are important advantages to the Navy's three-step concept of operations. Most important, replenishing combat ships from station ships minimizes the time that the combat ships are involved in underway replenishment operations. This increases the time they will be available for battle.

CURRENT DEFICIENCIES IN COMBAT LOGISTICS SUPPORT

Today, the Navy does not have the number of vessels it believes are needed to carry out resupply operations. It currently has 56 CLF ships, but its requirements call for 65 ships (see Summary Table 1). This goal is based on extended operations during a global war. The requirements make a variety of highly uncertain but not unrealistic assumptions about the scale of a future war as well as the location of fighting forces and available forward bases.

The Navy's goal for CLF inventories, and hence current shortfalls, may be understated. The Navy's view of requirements assumes that CLF ships are provided for battle groups centered around aircraft carriers. But CLF ships are provided neither for battle groups centered around the Navy's four battleships, which would probably operate independently of aircraft carriers, nor for the amphibious ships that would transport Marines. Nor do Navy requirements reflect operational changes that could be necessary because of the nature of the fleet replenishment oilers that travel with the battle groups. These vessels have limited capacity to carry ammunition, and may need to be accompanied by a separate ammunition ship, thus exacerbating the shortage of ammunition ships.

Fully meeting all these requirements could demand as many as 93 CLF ships. That number is probably an upper bound since it assumes simultaneous, widely dispersed operations that are unlikely even in a major war. The missions of some of these 93 ships could also be met by merchant ships, though Navy vessels are better suited to CLF operations than merchant ships. Nonetheless, this alternative view of requirements (referred to as the alternative goal) suggests that the Navy's goal for 65 CLF ships is conservative.

SUMMARY TABLE 1. CLF SHIPS: NAVY GOAL, CURRENT INVENTORY, AND PLANNED PURCHASES (Number of ships)

Ship Type	Navy Goal	Current Inventory	Planned Purchases 1989-1992 (Administration Plan)	Projected Inventory in 1996
Shuttle Ships				
Oilers	24	22	5	24
Ammunition Ships	16	13	2	15
Stores Ships	10	10	0	10
Station Ships				
Fast Combat Support Ships and Fleet Replenishment Oilers	15 a/	11 b/	3 c/	15 d/
Total	65	56	10	64

SOURCE: Congressional Budget Office based on Department of the Navy data.

NOTE: CLF = Combat Logistics Force.

a. The Navy does not establish separate goals for fast combat support ships and fleet replenishment oilers.

b. Four fast combat support ships and seven fleet replenishment oilers. One more fast combat support ship is under construction.

c. Three fast combat support ships.

d. Eight fast combat support ships and seven fleet replenishment oilers.

Speed of the Fleet Replenishment Oilers

Apart from influencing numerical shortfalls, the Navy's fleet replenishment oilers pose problems because of their relatively slow speed. The top speed for these ships, which travel with the battle group, is about 20 knots, whereas ships in an aircraft carrier battle group can travel at a top speed of about 30 knots. To allow its fleet replenishment oilers to keep pace, the whole battle group might have to slow down, which would impose operational restrictions in time of war. A slowdown could also delay the arrival of aircraft carriers in a crisis or limit the effectiveness of tactics to avoid enemy submarines. One potential solution is to buy more fast combat support ships to travel with the battle group. These ships have a top speed of about 26 knots.

ADMINISTRATION PLAN

In its most recent shipbuilding plan, the Administration addressed some of these key issues with plans to buy 10 new CLF ships during the period from 1989 through 1992 (see Summary Table 2). The Administration shipbuilding plan accompanied the budget submitted to the Congress in February 1988. However, the Administration has not revised the final three years of the plan--1990 through 1992--to accommodate the Department of Defense's expected funding levels, which were recently lowered. Therefore, the Administration may make changes to the current plan, beyond 1989, when a new plan is prepared later this year.

The current Administration plan makes improvements in the CLF and would meet most of the Navy's requirements. By 1996, when all the ships purchased under the Administration plan have entered the inventory, the Navy would have 64 CLF ships. That would leave the Navy short of its goal by only one ammunition ship. (This projection assumes that the Navy retires ships after 40 years of service unless those ships are needed to meet a specific shortfall. The Navy's actual plan for retirements is not publicly available.)

The total cost for CLF ships under the current Administration plan is $2.7 billion. This amounts to about 6 percent of total planned

spending for shipbuilding, 50 percent higher than the average of 4 percent accorded to CLF ships between 1962 and 1988.

While meeting most shortages relative to Navy requirements, the Administration plan does not make progress toward achieving the larger inventory of ships consistent with the alternative view of CLF requirements. Perhaps more important, it does little to solve the problem of the fleet replenishment oilers with their limited capacity for carrying ammunition and their low speed that could slow down a battle group.

OTHER OPTIONS

The three options discussed in this study are consistent with widely varying views about appropriate priorities for the CLF fleet. One

SUMMARY TABLE 2. EFFECTS OF ADMINISTRATION PLAN AND OPTIONS ON NUMBER AND COST OF CLF SHIPS

	Total Cost of CLF Ships 1989-1992 (Budget authority in billions of 1989 dollars)	Percentage of SCN Budget Allocated to CLF 1989-1992	Number of CLF Ships		
			Purchased 1989-1992	Inventory in 1996	Over Age 40 in 1996
Administration Plan	2.7	6	10	64	2
Option I	1.7	4	6	62	4
Option II	3.5	8	13	65	0
Option III	4.1	9	14	68	2

SOURCE: Department of the Navy data and Congressional Budget Office projections.

NOTE: SCN = Shipbuilding and Conversion, Navy Account; CLF = Combat Logistics Force.

option reduces the CLF's share of shipbuilding funds while the other two increase it substantially in order to address some of the issues confronting CLF planners. To reflect budget realities, all the options assume constraints on total funds for shipbuilding. For illustration, it is assumed that total shipbuilding funds do not grow in real terms beyond the level appropriated in 1987. Summary Table 2 shows the different costs and effects of the different options.

Option I: Reduce Procurement

Option I reduces to 4 percent the share of the constant shipbuilding budget available to CLF ships. This share is consistent with history over the last 25 years, but it is less than the 6 percent accorded to CLF ships under the Administration plan. To accommodate reduced funding, this option assumes that only six ships are purchased, rather than the ten purchased under the Administration plan. The four ships cut from the purchase plan are two oilers, one fast combat support ship, and one ammunition ship. As a partial offset to reduced procurements, some ships are retained past 40 years of age when they are needed to meet goals.

The primary advantage of this option is that it could make a modestly larger amount of money available for the construction of combat ships. Zero real growth in the total shipbuilding budget would require reductions below the Administration plan totaling $2.4 billion between 1989 and 1992. If the CLF receives a share of 4 percent, non-CLF funding would have to be cut by $1.4 billion. With a share of 6 percent, non-CLF cuts would have to be larger, about $2.3 billion. This option would therefore save about $0.9 billion in cuts in combat ship funding.

On the other hand, Option I has important drawbacks. Because delays in retirements do not fully offset reduced procurements, by 1996 there is a slightly larger shortfall relative to Navy requirements under this option (three ships) compared with the Administration plan (one ship). Also, by keeping ships longer, the option results in a slightly older fleet relative to the Administration plan, and could demand more funding in the 1990s. Moreover, it does not address concerns raised above: actual requirements may be larger than those acknowl-

edged by the Navy, and problems with the fleet replenishment oilers could hamper battle group operations.

Option II: Eliminate Shortfall and Retire Older Ships

Option II buys enough CLF ships (13 over the next four years) to meet all shortfalls relative to Navy requirements while retiring all ships at 40 years of age. The ships added to the Administration plan include one oiler and two ammunition ships.

By achieving a slightly larger and more modern CLF fleet than does the Administration plan, this option reduces the risk that logistics support will be inadequate. It also avoids postponing the problem of an old CLF fleet into the late 1990s, since it retires all ships after 40 years of service.

This option requires 8 percent of the constant shipbuilding budget, however, well above the level in the Administration plan and twice the historical level. Small reductions may therefore be necessary in other types of shipbuilding projects, including the construction of new combat ships. Relative to the Administration plan, this option adds $0.7 billion in CLF funds. The increased funding could be paid for by buying roughly one fewer SSN-688 Los Angeles class nuclear attack submarine, one fewer DDG-51 Arleigh Burke class guided missile destroyer, or one fewer LHD-1 Wasp class amphibious assault ship. While these reductions may seem modest in light of potential improvements in logistics support, they would have to be made in the context of budget tightening that may have already required reductions in the number of combat ships from Administration plans. In that context the further reductions, though modest, may be important.

Moreover, despite the added funds, this option does not make substantial progress toward resolving several key issues facing CLF planners. The option does not increase the number of ships enough to move significantly toward meeting the alternative view of requirements. Nor does it do enough (despite the one added ammunition ship that increases ammunition carrying capability) to solve the problems associated with the fleet replenishment oilers.

Option III: Solve Problem of Fleet Replenishment Oilers

To confront the problem of the fleet replenishment oilers, this option adds to the Administration plan four fast combat support ships, the largest and fastest logistics ships that accompany battle groups. When these enter the fleet, the Navy could serve four more aircraft carrier battle groups with a fast combat support ship, which should decrease problems associated with CLF ships slowing down faster battle groups. The fleet replenishment oilers freed up by this reassignment would provide some CLF capability for battle groups centered around battleships. In addition, the large fast combat support ships have greater capacity than fleet replenishment oilers for ammunition, which reduces the need to pair an ammunition ship with the replenishment oiler accompanying a carrier battle group and so avoids exacerbating the short supply of ammunition ships.

This option would certainly not solve all the problems facing CLF planners. By 1996, there would be 68 ships in the fleet, more than under the Administration plan but less than the 93 ships envisioned under the alternative view of requirements. Also, three aircraft carrier battle groups would still be served by the slower fleet replenishment oilers. Nonetheless, this option would significantly improve CLF capability.

It would, however, require that 9 percent of total shipbuilding funds be provided to CLF ships, more than twice the historical share and well above the share under the Administration plan. This larger share would mean larger cuts in funds for non-CLF ships, including combat vessels. While canceling procurement of only a few combat vessels would offset this larger share, those cancellations may be important in the context of reductions already made to accommodate reduced shipbuilding budgets.

CONCLUSION

None of these three options would alter the CLF fleet markedly over the next decade. For example, no option adds more than four ships to the number that would be present under the Administration plan. It is difficult to make rapid changes in a fleet that has been built up over

decades, especially during a period when shipbuilding budgets are assumed to be tightly constrained. Nonetheless, these options describe widely varying approaches to CLF ships that, if pursued consistently for many years, would substantially change the characteristics of the CLF fleet.

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CHAPTER I

INTRODUCTION

In its effort to build the 600-ship Navy, the Reagan Administration has not simply attempted to increase the size of the fleet to 600 ships. Rather, the "600-ship Navy" refers to an expanded fleet with a distinct combination of different types of ships--most important, 15 deployable aircraft carriers and their escort vessels.1/ In addition, the Administration embarked on a program to renovate and recommission four World War II era battleships and create four "surface action groups" around each, and to increase the Navy's capacity for transporting Marines and their equipment.

The Navy's logistics system may also have to grow to support the enlarged fleet. The Combat Logistics Force (CLF) is a major component of the Navy's logistics establishment. The CLF delivers petroleum products, food and dry goods, and ammunition to combat ships at sea. (Since the process of resupply at sea is known as "underway replenishment," the term "UNREP ships" is often used to describe the CLF. The Navy previously referred to the CLF as the "Mobile Logistics Support Force.")

IMPORTANCE OF THE CLF

The defense commitments of the United States require the Navy to carry out operations in areas that may be far from friendly ports. By eliminating the need to gain access to nearby ports for resupply in wartime, replenishment at sea allows the Navy to operate effectively

1. The Administration inherited a fleet of 13 deployable aircraft carriers. The Navy does not consider carriers undergoing a Service Life Extension Program (SLEP), a major overhaul, to be "deployable" because so much of the ship is disassembled during the overhaul that it would take a substantial period of time in an emergency to ready it for deployment. According to Navy plans, aircraft carriers will be rotated into the SLEP, one at a time, through the 1990s. The Navy therefore requires 16 aircraft carriers to support 15 deployable carriers.

far from land-based supply depots. In addition, supplying ships at sea provides flexibility and endurance in naval operations. Because surface ships have finite storage capacities for fuel, ammunition, and food and other dry goods, the Navy's ability to sustain wartime operations is critically dependent on regular resupply at sea. Without a sufficient number of CLF replenishment vessels, it would be virtually impossible for the Navy to carry out its essential wartime tasks: protecting the sea lines of communication between the United States and theaters of war, striking sea- and land-based targets, and transporting Marines for amphibious assaults.

In peacetime, an adequate force of logistics ships enhances conventional deterrence. A naval force that can be supported at sea for prolonged periods indicates to potential enemies that U.S. naval forces are ready to fight and remain in the battle for as long as necessary. Moreover, the Navy's preparedness for war is increased because crews practice underway replenishment routinely in peacetime.

MEETING FORCE GOALS FOR THE CLF

Despite the importance of CLF ships and the recent buildup in defense budgets, the Navy has not yet procured enough ships to meet its own force goals for the CLF. If all the ships in the most recent Administration shipbuilding plan are procured, most requirements will be met. But Navy requirements for CLF ships may be understated because, in part, they make assumptions that may not necessarily hold true during wartime operations. Moreover, the Administration shipbuilding plans for 1990 through 1992, which were included in the budget submitted to the Congress in February 1988, have not been updated by the Administration since January 1987. Since then, the Administration has agreed to reduce that budget substantially as part of the effort to reduce the federal deficit. If history is a guide, that action will lead to reduced purchases of CLF ships. Thus, the Navy's requirements may not be met under a revised plan.

As they plan for leaner budgets, the Congress and the Navy must make crucial choices. Should the Navy accept some shortfalls in CLF ships in order to minimize cutbacks in the procurement of combat ships and aircraft? Or should purchases of combat ships be reduced

modestly to fund fully the needs for CLF ships in order to avoid any degradation in the capability of combat ships stemming from logistics problems? This study explores these choices and presents options the Congress might wish to consider.

CHAPTER II

ESTABLISHING FORCE GOALS FOR LOGISTICS SHIPS

The Navy developed the ability to resupply warships at sea (underway replenishment) during the first half of this century. In the period around World War I, major naval combat ships switched from burning coal to oil. This switch made refueling at sea feasible, because oil can be transferred in volume at sea much more easily than coal. As a result, refueling at sea became routine. During the island-hopping campaigns in the Pacific during World War II, the Navy developed the equipment needed to transfer ammunition between ships.

The most important military advantage of refueling and rearming at sea was an increase in staying power. Combat ships no longer needed to leave the battle to travel to a friendly port to receive fuel and ammunition. While they continued the battle "on station," needed supplies could be brought in by dedicated, and less costly, logistics ships.1/ As long as the supplies kept flowing, the fighting forces could remain in combat for as long as required. Underway replenishment, therefore, marked a significant increase in the Navy's ability to sustain operations for periods beyond several days.

Today, the Navy replenishes ships at sea on a routine basis for peacetime operations, which require fuel, food, and other dry goods. Although it is not consumed in peacetime, ammunition is also transferred between supply ships and combat ships routinely for practice. Underway replenishment eliminates the need for port calls and trains the crews of supply and combat ships to conduct resupply operations as they would in wartime.

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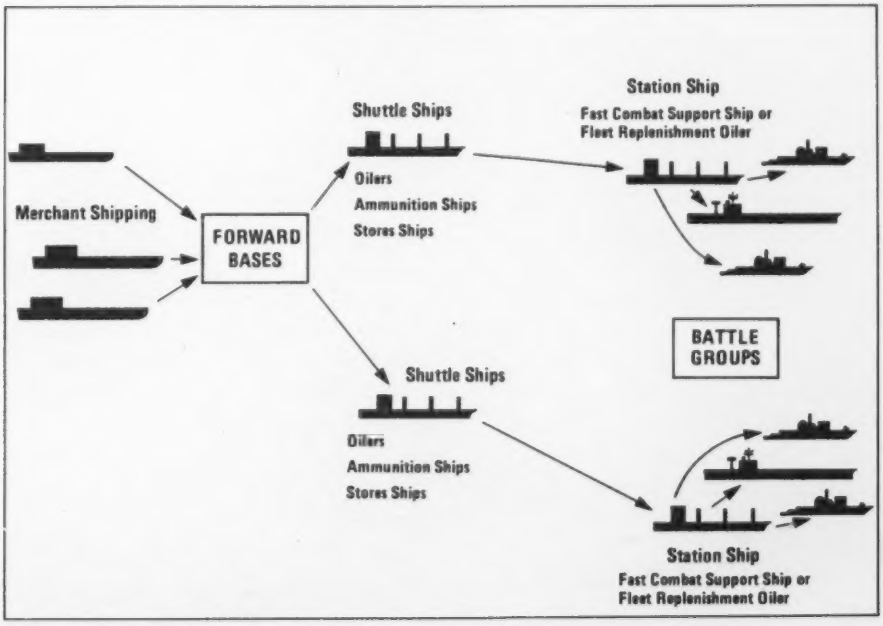
1. During World War II, for example, combat ships steamed about 200 miles away from the battle to receive supplies from logistics ships. Warships' combat capabilities can be limited during underway replenishment, and therefore resupply has historically been performed in areas where there is a low probability of enemy attack. Some World War II operations were carried out more than 1,000 miles from the nearest port that could support resupply operations. Thus, steaming 200 miles from the front to receive supplies meant that ships would be away from the battle for only a few, rather than several, days. See Marvin O. Miller, "Mobile Logistics Support for Aircraft Carriers," *Naval Engineers Journal*, vol. 89 (August 1977), pp. 54-55.

UNDERWAY REPLENISHMENT DURING WAR

In wartime, underway replenishment would assume greater importance and become more complicated than in peacetime. Current Navy plans use merchant ships, single-product shuttle ships, and multi-product station ships as part of a three-step process to resupply forces at sea.

The wartime replenishment process is pictured in Figure 1. In the first step, merchant ships transport supplies from the United States to ports or naval bases located as close as possible to the fighting forces. The Navy refers to such ports as "forward bases." For example, the

Figure 1.
Underway Replenishment Operations



SOURCE: Congressional Budget Office.

naval bases at Diego Garcia in the Indian Ocean, Subic Bay in the Philippines, or Yokosuka in Japan could be used as forward bases to handle supplies en route to forces in the Pacific or Indian oceans.

In the second step, supplies are consolidated and transferred to single-product Navy "shuttle" ships: aircraft fuel, diesel fuel, and other petroleum products are loaded on oilers; ammunition is placed on board specially designed ammunition transport ships; and stores are loaded on stores ships. The shuttle ships, escorted by a small group of combat ships, then steam to the battle group. (A battle group consists of an aircraft carrier and escort ships that protect the carrier.) Upon meeting the battle group, each shuttle ship transfers its supplies to a multi-product "station" ship (a fast combat support ship or fleet replenishment oiler), which will be steaming as a member of the battle group. Although Navy plans center on having the shuttle ships transfer their supplies to a station ship, the shuttle ships have the capability to transfer their goods directly to combat ships if necessary.

In the third step, the station ships transfer goods to the combat ships. The station ship can operate as a "gas station," where the fighting ships of the battle group steam to a rendezvous point within the perimeter of the battle group, or as a "delivery truck," where the station ship steams out to the combat ships. Station ships can transfer goods to two combat ships at one time, since they are equipped with fuel and cargo transfer equipment on both sides of the ship. (The Appendix addresses some of the issues associated with transferring ammunition to cruisers and destroyers.) The various types of station ships and shuttle ships that make up the CLF are described in Box 1.

Advantages of Using Station Ships and Shuttle Ships

There are advantages to this complex use of shuttle ships to transfer goods to station ships for delivery to combat vessels. One advantage is a reduction in the amount of time combat ships spend in resupply operations ("alongside time"). Because petroleum products, ammunition, and stores can be transferred from the station ship simultaneously, combat ships can receive all three products in the time it

BOX 1
SHIPS OF THE COMBAT LOGISTICS FORCE

Five types of ships make up the Combat Logistics Force: fast combat support ships, fleet replenishment oilers, ammunition ships, oilers, and stores ships. The five types of ships fall into two categories: station ships and shuttle ships. The terms station ship and shuttle ship are derived from the Navy's concept of operations for underway replenishment.

Station Ships

Fast combat support ships (AOEs) and **fleet replenishment oilers (AORs)** are both station ships. Navy plans call for these ships to travel with aircraft carrier battle groups. Station ships carry each of the three types of products that the Navy transfers from logistics ships to combat ships at sea: petroleum products, food and dry goods (stores), and ammunition. Both types of station ships have helicopter hangars and landing pads, since helicopters are used--along with other methods--to ferry supplies between ships during resupply operations.

The existing fleet of fast combat support ships is composed of four ships of the Sacramento class. These vessels were delivered to the Navy between 1964 and 1970. Each displaces 53,600 tons when fully loaded. Fast combat support ships are capable of steaming at about 26 knots. The ships have the capacity to carry approximately 177,000 barrels of petroleum products, 2,100 tons of ammunition, and 500 tons of stores. The Congress authorized the first of a new class of fast combat support ships in fiscal year 1987. This vessel is under construction and is scheduled to join the fleet around 1991. The most recent Administration shipbuilding plan requests one fast combat support ship in 1989 and two in 1991. The new fast combat support ships will cost about $0.4 billion each.

There are seven Wichita class fleet replenishment oilers. These ships were delivered between 1969 and 1976, and are a little smaller than the fast combat support ships. The fleet replenishment oilers displace 41,350 tons fully loaded and their maximum speed is around 20 knots. Each ship carries about 170,000 barrels of petroleum products, 600 tons of ammunition, and 300 tons of stores. At the time of their purchase, replenishment oilers cost about $0.2 billion (1989 dollars).

Two critical differences distinguish the fast combat support ships from the fleet replenishment oilers. The fleet replenishment oiler has less than one-third of the carrying capacity for ammunition of the fast combat support ship (600 tons compared with 2,100 tons). In addition, the fleet replenishment oiler is a slower ship compared with the fast combat support ship (20 knots compared with 26 knots).

Shuttle Ships

Three types of ships are included in the shuttle ship category: **oilers (AOs and T-AOs)**, **ammunition ships (AEs and T-AEs)**, and **stores ships (AFSs and T-AFSs)**. In contrast to the station ships, each of which carries all three types of supplies (petroleum products, ammunition, and stores), the shuttle ships are designed to carry only one product. In the Navy's concept of operations, the shuttle ships transport their goods from land-based logistics depots to station ships, which in turn deliver the supplies to combat ships.

Currently, 22 oilers are in the Navy's inventory. There are five different classes of oilers. These range from two ships of the Ashtabula class commissioned in 1945 to four new ships of the Henry J. Kaiser class. Nine more ships of the Kaiser class have been authorized by the Congress, but have not yet entered the active inventory. The displacement of the oilers (when loaded) ranges from about 27,000 to 40,000 tons. The carrying capacity of the oilers varies between 120,000 to 180,000 barrels of petroleum products, and their maximum speed varies from about 16 knots to 20 knots, depending on the class. New oilers cost approximately $0.2 billion each.

The 13 ammunition ships are designed to transport and transfer ammunition. Five Suribachi class ships were delivered in the late 1950s. (Ships of this class will reach the end of their expected service life in the late 1990s.) Eight Kilauea class ships were delivered in the late 1960s and early 1970s. The ships' full load displacements are about 17,500 (Suribachi class) or 20,000 tons (Kilauea class). Each ship carries up to 6,500 tons of ammunition, and the maximum speed is around 20 knots for both classes. The Administration's most recent shipbuilding plan requests new ammunition ships in 1991 and 1992, with a unit cost of about $0.4 billion.

There are a total of 10 stores ships: seven Mars class ships, delivered between 1963 and 1970, and three ships purchased from Great Britain between 1981 and 1984. These vessels displace about 16,500 tons when loaded, and their maximum speed is 19 knots for the vessels purchased from Great Britain and 21 knots for the Mars class ships. The Mars class vessels are capable of carrying about 7,000 tons of food, dry goods, spare parts, and other stores. At the time of their purchase, the Mars class ships cost about $0.2 billion (1989 dollars) each.

SOURCE: Congressional Budget Office based on data from the Department of the Navy and Norman Polmar, *The Ships and Aircraft of the U.S. Fleet, Fourteenth Edition* (Annapolis: Naval Institute Press, 1987).

typically takes to receive petroleum products. Reduced alongside time translates into more time in battle and decreased vulnerability.2/

Increasing the staying power of the battle group is another advantage of the Navy's concept of operations. Historically, when combat ships needed supplies, they had to steam to meet supply ships in safe havens. In contrast, the current Navy plan envisages the station ships steaming as integral members of aircraft carrier battle groups. With supply ships in place with the battle group, it can fight longer than would be the case if the supply ships were away from the battle in a safe haven or if the combat ships had to steam to port for resupply. A typical aircraft carrier battle group, exclusive of a station ship, carries with it enough materiel for about five days of combat before it requires replenishment. (Combat ships generally require replenishment when their inventories reach a threshold, and not when they are completely empty.) With a station ship added, the group can operate for about 15 days before it requires outside replenishment. Thus, the station ships allow the combat ships to remain in battle for an extended period.

NAVY FORCE GOALS FOR CLF SHIPS

How does the Navy establish force goals (requirements) for underway replenishment ships? The requirements for Combat Logistics Force ships are closely related to the Navy's concept of resupplying combat ships, the number of the fighting ships in the fleet, and the type of operations or "scenarios" that must be supported.

Planning for the Worst Case

While a variety of wartime scenarios can be used to plan force levels, the most challenging scenario that could reasonably be anticipated is

2. Combat ships are vulnerable during underway replenishment for a number of reasons. Ships travel at reduced speeds during replenishment, which could make them easier targets for enemy submarines. Because the supply ship and combat ship are connected by high-tension wires, they must steam in parallel, and maneuverability, an important defensive tactic, is reduced. In addition, some weapons systems may be inoperable while they are being resupplied, and the performance of some shipboard sensors may be degraded by the proximity of another ship.

usually chosen for this purpose. If planning supports more challenging contingencies, the Navy argues, then they can be confident that less difficult tasks can be accomplished satisfactorily.

A major war in Europe against Warsaw Pact forces would be a part of most worst-case scenarios used for planning purposes. Although the United States would fight such a war in concert with the allies of the North Atlantic Treaty Organization (NATO), planning for underway replenishment forces remains a national responsibility.3/ Therefore, when planning its force requirements, the United States does not take into account the resupply support that could be provided by NATO allies.

Navy Force Goals

The Navy's force goals for CLF ships and the current inventory of CLF ships appear in Table 1. For station ships, the Navy's goal is to have one fleet replenishment oiler or one fast combat support ship available to steam with each deployable aircraft carrier. Because the Navy is building toward 15 aircraft carriers, the force goal for station ships is also 15. In the Navy's plans, the fleet replenishment oiler and the fast combat support ship are considered equally satisfactory in the station ship role.4/

The methodology used by the Navy to develop force goals for shuttle ships is much more dependent on detailed analyses than that used for the station ships, and requires the exercise of judgment to determine a specific force goal. The following equation is used to

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3. A total of about 54 ships capable of replenishing warships at sea are in the inventories of NATO allies of the United States. POL (petroleum, oil, and lubricants) is the product most likely to be transferred between ships from NATO allies and U.S. Navy ships because (1) the different navies use the same petroleum products and (2) the equipment necessary for underway replenishment of POL, such as fueling probes and couplings, is compatible among the navies of NATO countries. In contrast, ammunition is generally not compatible, and the United States is therefore more likely to rely exclusively on U.S. ships for resupply in that case.

4. The fleet replenishment oiler's slower speed (20 versus 26 knots) and smaller ammunition carrying capacity (600 versus 2,100 tons) make it a less capable station ship than the fast combat support ship.

estimate requirements for each of the three types of shuttle ships (oilers, ammunition ships, and stores ships):

$$\text{Number required} = \frac{\text{Cycle Time x Daily Demand for Supplies}}{\text{Shuttle Ship Storage Capacity}}$$

where

$$\text{Cycle time} = \frac{\text{Roundtrip Distance to Forward Base}}{24 \times \text{Speed}} + \text{Load/Unload Time}$$

This equation yields the minimum number of shuttle ships that the Navy believes would be required to maintain adequate supplies for aircraft carrier battle groups.

The equation will yield a range of "requirements" for shuttle ships when the assumptions and planning factors for different scenarios are used to derive daily demand and distance to the closest port. Once the range of possible requirements is determined from a range of scenarios, a specific requirement is chosen based on a best guess about needs in a future war. The Navy requirements shown in Table 1 are based on assumptions that are optimistic, but not unrealistic.

DOES NAVY PLANNING UNDERESTIMATE REQUIREMENTS?

While not unrealistic, the Navy's force planning may underestimate the requirements for CLF ships because it does not allocate station ships or shuttle ships to the four battleship surface action groups or to the amphibious warfare ships that would transport Marines during a global war.5/ When battleship groups operate, they are frequently supported by a station ship. If amphibious forces are deployed abroad, they would need to be resupplied at sea by the CLF. Navy force plan-

5. It is important not to confuse the assumptions used for the purposes of determining force structure and "requirements" with the process that establishes plans and options for actually fighting wars. For the purposes of planning force levels, the Navy does not explicitly take account of the need to resupply battleship surface action groups and amphibious warfare groups. On the other hand, the commanders-in-chief of the unified commands, those with the responsibility for actually fighting wars, no doubt take into consideration the need to resupply the battleship surface action groups and amphibious warfare ships when they plan wartime deployments.

ning may underestimate requirements because it ignores the battleship groups and amphibious warfare forces. Also, the Navy's requirements do not contain "extra" CLF ships to compensate for vessels lost in battle.

Why would the Navy arrive at lower estimates of requirements than could be defended? In part, the answer reflects legitimate

TABLE 1. CURRENT GOALS FOR THE CLF AND AVAILABLE SHIPS
(Number of ships)

Ship Type	Navy Goal	Alternative Goal	Current Inventory and Ships Authorized a/
Fast Combat Support Ships and Fleet Replenishment Oilers	15 b/	19 c/	12 d/
Oilers	24	32	24 e/
Ammunition Ships	16	28	13
Stores Ships	10 f/	14	10
Total	65	93	59

SOURCE: Congressional Budget Office and Department of the Navy data.

NOTE: CLF = Combat Logistics Force.

a. Funded through 1988.

b. The Navy does not establish separate goals for fast combat support ships and fleet replenishment oilers.

c. Twelve fast combat support ships and seven fleet replenishment oilers.

d. Five fast combat support ships and seven fleet replenishment oilers.

e. The oiler inventory will depend on the number of older ships retired by the Navy.

f. Does not include one older refrigerated stores ship.

differences of opinion about the nature of a future and highly uncertain war. Large requirements for CLF ships would also drive demand for large purchases, which would reduce funds available for other ships and aircraft. The Navy may have decided it would prefer to purchase combat vessels and incur the risk that it might have too few CLF ships. This may be a reasonable decision, but the possible magnitude of the "full" requirement for CLF ships must also be evaluated.

In addition to underestimates resulting from battleship groups and amphibious operations, the Navy may be underestimating the requirement for ammunition ships for other reasons. As noted in Table 1, the Navy estimates that it requires 16 ammunition ships. This estimate assumes that these ammunition ships are used only in their primary role, shuttling ammunition from forward bases to carrier battle groups for transfer to the multiproduct station ships--fast combat support ships and fleet replenishment oilers--that deliver the goods to combat vessels. But the seven fleet replenishment oilers currently in use as station ships have limited capacity to carry ammunition. Thus, during wartime, when ammunition supplies would clearly be critical, fleet commanders may operate an ammunition ship as a station ship along with each fleet replenishment oiler. If an ammunition ship is added to accompany each fleet replenishment oiler, then the requirement for ammunition ships increases from 16 ships to 23.

Meeting the needs of battleship groups and amphibious groups, as well as providing extra ammunition ships to supplement the ammunition capacity of the fleet replenishment oilers, brings requirements for CLF ships to a total of 93 ships. In contrast, the Navy's requirements call for a total of 65 ships.

Whether or not this difference in determining requirements will have significant military consequences in a war depends on the scope and intensity of the fighting. This alternative view of requirements (alternative goal) is based on having virtually every ship in the Navy's inventory widely dispersed and engaged in intensive combat operations. The probability that such operations will be carried out, even in the context of a global war with significant naval activity, is low. Thus, the goal of 93 ships (see Table 1) is probably an upper bound, but it may suggest that the Navy's goal of 65 ships is conservative.

Problem of Fleet Replenishment Oilers

Navy requirements may not only understate numerical needs; they may also include ships that are too slow to keep up with the carrier battle groups. The slower ships may therefore need to be replaced before their normal retirement ages, and such replacements could drive up funding requirements.

As noted above, the Navy uses both fleet replenishment oilers and fast combat support ships as station ships that actually deliver products to aircraft carriers and other combat ships. The maximum speed of ships likely to be part of an aircraft carrier battle group--the carrier, cruisers, destroyers, frigates, and attack submarines--is around 30 knots. The fast combat support ship's maximum speed is about 26 knots while the fleet replenishment oiler's maximum speed is about 20 knots. Since a battle group can travel only as fast as its slowest member, and in wartime the Navy intends to have station ships steam together with aircraft carrier battle groups, the 20-knot speed of the replenishment oilers severely limits the speed of the battle groups of which they are a part.6/ When a fast combat support ship travels with a battle group, speed is limited, but not nearly as severely.7/

The replenishment oiler's slower speed has an important influence on battle groups' operations and tactics. For example, speed is frequently cited as an effective tactic for evading enemy submarines. Attack submarines hunt most effectively when they are traveling at relatively slower speeds. At higher speeds, the noise created by the submarine's propagation through the ocean may degrade, and perhaps eliminate altogether, its sensors' ability to locate ships and other submarines. In addition, the noise generated at higher speeds makes the attacking submarine easier for defending forces to detect, target, and destroy. Thus, once United States warships have reason to believe that they are close to an enemy submarine, an effective tactic for evading the threat would be to increase speed. With a 20-knot fleet replenishment oiler as part of the battle group, the group's ability to

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6. Ammunition ships, which would probably team up with each fleet replenishment oiler to serve as an ammunition station ship, also have a maximum speed of about 20 knots.

7. Seven fleet replenishment oilers and five fast combat support ships have been funded through 1988. Thus, in a war, the majority of aircraft carrier battle groups would operate with fleet replenishment oilers.

sprint away and evade enemy submarines may be limited, and the effectiveness of this tactic reduced. Given the high value of the supplies carried by replenishment oilers, leaving these ships behind--and potentially less well defended--during a sprint is highly undesirable.

The ability of battle groups to deploy rapidly in a crisis is also limited by the replenishment oilers' relatively slower speed. In a crisis, battle groups based in the Atlantic that are equipped with fast combat support ships will arrive at trouble spots--for example, in the North Atlantic or the Mediterranean--several days before battle groups traveling with replenishment oilers.8/ The difference in response time in the Pacific theater would be greater because of the longer distances involved.

The slower speed of replenishment oilers may also make it difficult to replenish warships when carrier battle groups operate in a dispersed formation. Current concepts of naval operations include formations in which the cruisers and destroyers that escort aircraft carriers are located up to 250 miles from the carriers in order to cover a wide area of ocean and make detection more difficult. During a war, it would be essential to resupply warships with ammunition and fuel as required. Given the slower speed of the replenishment oilers and the distances envisaged in current naval tactics, it may be difficult, or perhaps impossible, for replenishment oilers to resupply dispersed warships at their combat stations. This difficulty might cause combat ships to retreat from the battle or cause the battle group commander to adjust other tactics in the face of a logistics support shortage.

IMPLICATIONS OF A SHORTAGE OF CLF SHIPS

The Navy has 59 CLF ships that are available now, or soon will be (see Table 1). The 59 ships include 56 that are now in the fleet plus 10 that are under construction and will enter the fleet within a few years.

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8. For example, suppose that in response to a crisis in Europe, aircraft carrier battle groups are ordered to deploy immediately from Norfolk, Virginia, to the Norwegian Sea, and that the distance the ships must travel is about 4,000 nautical miles. Assuming that battle groups equipped with fast combat support ships travel at an average speed of 20 knots, they would reach their objectives in about 8 days. In contrast, battle groups equipped with fleet replenishment oilers, steaming at an average speed of 15 knots, would arrive in about 11 days.

(The Navy will probably retire seven oilers over the same period, leading to a 59-ship CLF.) Thus, relative to Navy requirements for 65 ships, the service is short six ships or about 10 percent. Relative to the alternative view of requirements (93 ships), the service is short 34 ships or about one-third of the total requirement.

By the Navy's reckoning, the current shortage consists of three fast combat support ships that actually deliver goods to carrier battle group vessels and three of the ammunition shuttle ships that move ammunition to and from forward bases for transfer to the multi-product station ships.9/ Relative to the alternative view of requirements, the shortages consist of 15 ammunition ships, 8 oilers, 4 stores ships, and 7 fast combat support ships.

What are the implications of these force shortfalls? A shortage of combat logistics ships may limit the tactical options available to fleet commanders. Fleet commanders would prefer to execute naval operations that have the highest probability of winning battles and wars, and believe that the logistics system should be capable of supporting these operations. An adequate fleet of combat logistics ships will provide enough ships and flexibility to support those operations judged to have the highest chance of military success. In other words, naval officers would prefer to face the question, "Of all of the options available, which will win this battle?" rather than, "Of all of the options that a short-handed logistics system will support, which is the best?"

But they may not face that choice. For example, the shortage of three station ships may mean that the Navy could not operate all of its aircraft carriers simultaneously, an obvious drawback in a major war. The shortage of ammunition shuttle ships may require that the Navy depend more on merchant vessels to deliver ammunition to the battle groups, even though these merchant vessels are already in demand to

9. For the purpose of calculating the size of shortfalls, this study assumes that the Navy will soon meet its goal of 24 oilers, even if that means keeping some oilers in service past their expected service life of 40 years. This appears to be consistent with current Navy practices.

carry ammunition from the United States to forward bases.10/ This problem in particular, and logistics problems in general, would be considerably worsened if the United States fails to gain access to forward bases near the location of combat operations.

An insufficient number of logistics ships may also determine whether the Navy can fight battles in different theaters simultaneously, or whether operations must be carried out sequentially. For example, during a major war, it may be most desirable for the Atlantic fleet to carry out simultaneous operations in the North Atlantic, the Mediterranean, and the Caribbean. The Pacific fleet might wish to operate in the Northwest Pacific and the Indian Ocean simultaneously. There are some questions as to whether or not the CLF could meet these disparate requirements at the same time, even if all Navy CLF requirements are filled. A shortfall of CLF ships would exacerbate the difficulties of supporting simultaneous operations.

If an adequate number of logistics ships is not available, then naval forces may not be able to sustain operations beyond the number of days of supply that they carry with them. A deficiency of shuttle ships may mean that combat ships have to withdraw from battle for want of critical supplies.11/

In sum, during a major war a shortage of logistics ships could diminish the sustainability of naval forces, reduce the capability to operate in different theaters simultaneously, and decrease the tactical options available to fleet commanders.

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10. Given the recent decline in the size of the U.S. merchant marine, this may be a particularly acute problem for the foreseeable future. For more information on the decline of U.S. merchant shipping that would be available during a war, see the Commission on Merchant Marine and Defense, *First Report of the Commission on Merchant Marine and Defense: Findings of Fact and Conclusions* (September 1987), and Congressional Budget Office, *U.S. Shipping and Shipbuilding: Trends and Policy Choices* (August 1984).

11. A shortage of only one item can cause a ship to withdraw. For example, a shortfall of oilers will cause conventionally powered ships that do not have their fuel supply replenished to withdraw. Anti-air warfare ships would probably have to withdraw if they cannot be resupplied with surface-to-air missiles; anti-submarine warfare ships will probably have to withdraw if they are not resupplied with anti-submarine rockets (ASROCs).

CHAPTER III

FORCE DEFICIENCIES UNDER THE ADMINISTRATION PLAN

The most recent shipbuilding plan submitted by the Administration would meet most of the Navy's requirements for Combat Logistics Force ships. It would still fall short, however, of requirements under the alternative view. Moreover, the shipbuilding plan is likely to be revised to meet budget constraints in ways that could decrease purchases of CLF ships and so fail to eliminate shortfalls relative to the Navy's current statement of requirements.

ADMINISTRATION SHIPBUILDING PLANS

Long-term shipbuilding plans for the Navy are currently uncertain. The Administration included a five-year shipbuilding plan--for 1988 through 1992--with its original 1988/1989 biennial budget, which was submitted to the Congress in January 1987. In December 1987, the Administration and the Congress concluded the "Budget Summit Agreement," which called for about $33 billion less in defense spending for 1989 than was anticipated in the original 1988/1989 request. To reflect reduced defense spending, in February 1988 the Administration submitted an amended budget request for 1989. The amended request included a shipbuilding plan that did not make any changes to the previous plan's purchases of ships from 1990 through 1992, including CLF ships, but cautioned that the plan is "subject to further review." While this study assumes that the shipbuilding plan submitted with the February 1988 budget reflects the Administration's intentions, the plan is likely to change in the near future. A table outlining the Administration's February 1988 plan is provided in Box 2.

BOX 2
ADMINISTRATION SHIPBUILDING PLAN
(Number of Ships)

	1989	Subject to Further Review 1990	1991	1992	1989-1992 Total
New Construction					
Trident (Ballistic Missile Submarine)	1	1	1	1	4
SSN-688 (Attack Submarine)	2	2	2	1	7
SSN-21 (Attack Submarine)	1	0	2	2	5
CVN (Aircraft Carrier)	0	1	0	0	1
CG-47 (Guided Missile Cruiser)	0	1	0	0	1
DDG-51 (Guided Missile Destroyer)	3	3	5	6	17
LHD-1 (Amphibious Ship)	1	0	1	0	2
LSD-41 (Landing Ship Dock-Cargo Variant)	0	1	1	2	4
MCM-1 (Mine Countermeasures Ship)	0	0	0	0	0
MHC-1 (Coastal Minehunter)	2	3	3	4	12
PXM (Patrol Craft)	0	1	0	4	5
AOE-6 (Fast Combat Support Ship)	1	0	2	0	3
AE-36 (Ammunition Ship)	0	0	1	1	2
ARS (Salvage Ship)	0	1	0	0	1
TAO-187 (Fleet Oiler)	2	2	1	0	5
TAGOS (Surveillance Ship)	3	3	2	0	8
AGOR (Research Ship)	1	2	4	0	7
Total	17	21	25	21	84
Conversion/SLEPs					
CV (Aircraft Carrier) SLEP	0	0	1	0	1
AO (Oiler) Conversion	2	1	0	0	3
TACS (Crane Ship) Conversion	0	0	0	0	0
Total	2	1	1	0	4

SOURCE: Department of Defense.

NOTES: The 1990-1992 portion of this table is identical to the one provided with the fiscal year 1988/1989 President's Budget submitted to the Congress in January 1987. Adjustments to these years can be anticipated based on Congressional actions in 1988 and further Department of Defense reviews.

SLEP = Service Life Extension Program.

TABLE 2. ADMINISTRATION SHIPBUILDING PLAN FOR CLF SHIPS

	1989		1990		1991		1992		Total	
	Number	Cost a/	Number	Cost a/	Number	Cost a/	Number	Cost a/	Number	Cost a/
Fast Combat Support Ships	1	0.4	--	b/	2	0.9	--	b/	3	1.3
Oilers	2	0.3	2	0.3	1	0.2	--	b/	5	0.8
Ammunition Ships	--	--	--	--	1	0.4	1	0.3	2	0.7
Total	3	0.7	2	0.3	4	1.4	1	0.3	10	2.7

SOURCE: Congressional Budget Office based on Department of the Navy data.

NOTES: Totals may not add due to rounding.

Dashes indicate that no ships in the relevant category are planned for that year.

CLF = Combat Logistics Force.

a. Budget authority in billions of 1989 dollars.

b. Less than $20 million for outfitting and post-delivery costs.

ADMINISTRATION FORCE GOALS FOR CLF SHIPS

The most recent shipbuilding plan submitted to the Congress by the Administration would eliminate most, but not all, of the shortage of logistics ships relative to the Navy's goals. The Administration requested authorizations for three fast combat support ships, five oilers, and two ammunition ships between 1989 and 1992. The total cost for all these ships is $2.7 billion in 1989 dollars.1/ The CLF shipbuilding plan is detailed in Table 2.

CLF vessels constitute about 6 percent of the budget for the construction of new ships from 1989 through 1992 in the Adminis-

1. The cost for these 10 ships combined is equal to about 80 percent of the cost of one aircraft carrier. Two aircraft carriers were funded in 1988.

tration's most recent plan.2/ During the 1962-1988 period, funds for new construction of CLF ships account for about 4 percent of the total funds for Navy shipbuilding and conversion (SCN funds). Thus, the Administration plan earmarks a proportion of the budget for CLF ships that is somewhat higher than the historical average.

Funds are also requested to upgrade the capacity of existing CLF ships. The Navy has embarked on a program to increase the carrying capacity of the five Cimarron class oilers. During the conversion, a "plug" will be inserted amidships to increase the ships' oil-carrying capacity from 120,000 to 180,000 barrels.3/ Congress approved the first Cimarron class oiler conversion in 1987. The remaining ships are to be converted between 1988 and 1990 (see Table 3). This pro-gram, when completed, will increase the carrying capacity of the oiler fleet by 8 percent. The capacity increase is approximately 7 percent of the total Navy goal for oiler capacity.

Adapting Merchant Vessels for Resupply Operations

In addition to constructing new underway replenishment ships and increasing the capacity of existing oilers, the Navy administers the Merchant Ship Naval Augmentation Program (MSNAP). MSNAP is dedicated to enhancing the ability of commercial ships to perform naval missions. A portion of MSNAP funds are directed at programs for underway replenishment. MSNAP funding for research and development has been about $5 million per year; somewhat greater, but still modest, amounts are spent for procurement under the program to provide features on merchant ships that enhance their ability to assist in wartime replenishment.4/

2. Calculations of the cost (budget authority) of the Administration plan do not include any costs for the construction of new aircraft carriers from 1989 to 1992.

3. The conversion program is sometimes referred to as "AO Jumboization."

4. The Congress did not fund the Administration's request for research and development for MSNAP in 1987 or 1988. The Administration did not request any MSNAP funds in its amended budget request for 1989.

Specifically, the portion of MSNAP that is dedicated to underway replenishment focuses on providing modular, self-contained stations that can transfer fuel and cargo from commercial tankers and cargo ships to naval vessels. Two systems for cargo and one for fuel transfer are being procured. The Navy plans to install the cargo systems on about 18 ships; self-contained refueling systems are planned for installation on 10 tankers.

The Navy has indicated that ships with MSNAP equipment can augment the supply capabilities of, but not substitute for, dedicated Navy supply ships. Merchant ships usually lack the characteristics that define a good Navy CLF ship. Most merchant ships, for example, are slower than Navy ships, and the reduced speed would probably limit the tactical options available to battle group commanders. Merchant ships are also usually designed and built to minimize the size of the crew to reduce commercial operating costs. CLF tasks would require more personnel than the ship could typically accommodate. The shortage of personnel could make underway replenishment tasks slow, inefficient, or even impossible. Moreover, vessels with MSNAP equipment have fewer replenishment stations per ship than CLF vessels, which would further slow resupply operations. Slow underway replenishment would generally increase alongside time, and hence increase vulnerability and reduce the time combat ships can spend in battle. The Navy also points to drawbacks inherent in merchant ships, such as instability in rough seas, restricted maneuverability, and the absence of crew training in peacetime.

TABLE 3. CONVERSION SCHEDULE FOR CIMARRON CLASS OILERS

	1987	1988	1989	1990	Total
Number of Ships Converted	1	1	2	1	5
Cost (Budget authority in millions of 1989 dollars)	42.5	45.4	85.3	45.4	218.6

SOURCE: Congressional Budget Office based on Department of the Navy data.

CLF INVENTORIES UNDER THE ADMINISTRATION PLAN

How will the Administration shipbuilding plan affect the inventory of CLF ships? Assuming that it takes four years for a CLF ship to enter the Navy inventory after it has been authorized by the Congress, the CLF ships in the plan will enter the inventory between 1993 and 1996. Inventory projections for 1996, therefore, reflect deployment of all ships included in the plan.

The Navy may also retire some CLF ships between now and 1996. Since the Navy does not publicly announce its ship retirement plans, it is not possible to predict the 1996 inventory with certainty. Probable retirements are especially important for the fleet of oilers. Of the current oiler fleet of 22 ships, 13 were built in the 1940s and 1950s. These older ships have reached the end of their expected 40-year service life, or will have by the mid-1990s. At the same time, the Navy has nine new oilers on order, which will be delivered between now and 1996.5/ One can therefore expect that the Navy will retire a number of the older oilers before 1996.

Retirements may also be important for the fleet of ammunition ships. Five ammunition ships will reach the end of their planned service life during the late 1990s. Assuming that new ammunition ships enter the fleet four years after they are authorized by the Congress, replacements for the older ammunition ships would require Congressional authorization beginning in the early 1990s.

The Navy must face a trade-off: it can retire older ships and experience a numerical shortfall relative to its force goals; or it can keep older vessels active, with the corresponding maintenance problems that one would expect for ships over 40 years old. Recent practices suggest that the Navy's preferred approach will be to keep older vessels in the fleet in order to achieve its numerical force goals. Therefore, this study assumes that the older vessels are kept in service, and that the 1996 inventory of oilers meets the Administration plan for 24 ships. Similarly, the study assumes that an older ammunition ship is retained to bring the inventory in 1996 to 15 ammunition ships, one short of the goal of 16.

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5. Two oilers authorized in 1988 are among the nine oilers on order.

Under these assumptions, the Administration plan would result in an inventory of 64 CLF ships by 1996 (see Table 4). This projection assumes not only that older ships are retained to meet force goals, but also that new shipbuilding programs do not run into delays. It also assumes that the Navy does not operate more ships than would be required to meet its force goals.

If the Administration shipbuilding plan is enacted as proposed and if all older ships are retired, the Navy will meet most of its own stated requirements. It would, however, still be short of its force goals, but only by at most three ships (one oiler and two ammunition ships).

The Administration plan would not, however, come close to meeting the alternative view of requirements discussed in Chapter II. That

TABLE 4. COMBAT LOGISTICS FORCE IN 1996
(Number of ships)

Ship Type	Navy Goal	CBO Projection a/
Fast Combat Support Ships and Fleet Replenishment Oilers	15 b/	15 c/
Oilers	24	24
Ammunition Ships	16	15
Stores Ships	10	10
Total	65	64

SOURCE: Congressional Budget Office based on Department of the Navy data.

a. Assumes all ships in the Administration shipbuilding plan are authorized and that ships 40 years old are retained to meet force goals.

b. The Navy does not establish separate goals for fast combat support ships and fleet replenishment oilers.

c. Eight fast combat support ships and seven fleet replenishment oilers.

view foresaw needs for as many as 93 CLF ships, far more than the Navy would have by 1996 or anytime in the forseeable future. The Navy has clearly chosen to accept any operational risks associated with not meeting this alternative goal.

FUTURE ADJUSTMENTS TO THE ADMINISTRATION PLAN

While the Administration plan would meet almost all of the Navy's stated requirements, future adjustments to that plan may well reduce numbers of CLF ships that are bought and hence still leave the Navy with a shortfall in ships by 1996. Assuming that beyond 1989, defense spending and spending for the Navy will grow sufficiently to offset the effects of inflation but no more, and that the SCN account will retain the same percentage of the total Navy budget that was planned in the January 1987 five-year defense plan, then overall funding in the shipbuilding account must be reduced by about $2.4 billion from the amount previously planned for fiscal years 1989 through 1992 (see Table 5).

TABLE 5. SHIPBUILDING AND CONVERSION, NAVY ACCOUNT: NO REAL GROWTH FROM 1987 COMPARED WITH ADMINISTRATION PLAN (Budget authority in billions of 1989 dollars)

	1989	1990	1991	1992	Total
No Real Growth from 1987	10.7	10.7	10.7	10.7	42.8
Administration Plan a/	9.1	9.2	14.2	12.6	45.1
Difference	1.6	1.5	-3.5	-1.9	-2.4

SOURCE: Congressional Budget Office based on Department of the Navy data.

NOTES: Totals may not add because of rounding.

a. Estimates of the Administration Plan for 1990 through 1992 are based on the shipbuilding plan submitted to the Congress in January 1987. These estimates were adjusted to exclude costs for the two new aircraft carriers that were authorized in 1988.

Historically, when faced with budget reductions, the Navy has tended to protect the construction of new combat ships and reduce or delay requests for new CLF ships. In January 1982, and again in January 1983, the Navy submitted five-year shipbuilding plans. The available dollars were reduced by the Congress below the requested level, though funding for shipbuilding remained well above its historical average. In response, the Navy revised the final four years of each five-year plan. These revisions suggest how the Navy might respond if the current Administration plan is cut back. While 67 percent of the combat ships the Navy planned to request in the final four years of the January 1982 five-year shipbuilding plan were subsequently requested in 1984 through 1987, only 44 percent of the planned CLF ships were requested. Analysis of the five-year plan submitted in January 1983 yields similar results: 82 percent of the combat ships, compared with only 46 percent of the CLF ships, that appear in the final four years in the plan were actually requested. Thus, even in years when the defense budget was growing--albeit not at the rates originally projected by the Administration--the Navy pared back its plans to build CLF ships. If the defense budget continues to decline in real terms--1989 will be the fourth consecutive year of real decline in the defense budget if the Administration's request is not increased by the Congress--the Navy may be even more inclined to scale back its plans to build new CLF ships. If ships in the Administration plan are not requested by the Navy, then the shortage of supply ships will be greater in 1996 than shown in Table 4.6/

Revisions to the Administration's budget could also reduce requirements for CLF ships. In its review of the 1988 defense budget, the Senate Appropriations Committee mandated retirement of an aircraft carrier, which would reduce CLF requirements. That change was not accepted by the Congress and may well not be considered by the Navy, which has made an increase to 15 deployable aircraft carriers one of its highest priorities. Nonetheless, other changes to the Navy's forces may be considered and could modify requirements.

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6. The Congress must fund vessels if they are to be built. In its budgets submitted for 1982 through 1988, the Navy requested a total of 14 oilers and 1 fast combat support ship. The Congress funded each of these vessels in the year in which it was requested, with the exception of one oiler in 1984. Thus, there is some evidence indicating that the Congress may look favorably upon Navy requests for CLF ships.

CHAPTER IV

ALTERNATIVE APPROACHES UNDER A CONSTRAINED BUDGET

Faced with severe budget constraints, the Congress and the Administration must decide whether to allocate substantially less funding to Combat Logistics Force ships, thereby avoiding larger cuts in the funding for combat ships but risking degradation in their wartime capability because of inadequate logistical support. Alternatively, the Congress could choose to allocate more funding to CLF ships at the expense of larger reductions in funding for combat ships. The three options discussed below vary widely in the portion of funds allocated to CLF ships, from the historical average of 4 percent of total shipbuilding funds (that is, Shipbuilding and Conversion, Navy account funds) up to 9 percent.

To illustrate possible budget limits, all the options assume no real growth in total SCN budget authority beyond the level appropriated in 1987.1/ An increase in the portion of funds for CLF ships must therefore be offset by reductions in other shipbuilding categories. (The choice of zero real growth is for illustration only. The actual rates of growth or decline will depend on decisions by the Congress about total defense funding, and on the allocation of those funds to specific programs.)

The capabilities of the CLF fleet--measured by the portion of requirements met and the number of older vessels still in use--do not vary as widely under the various options as the percentage of funds allocated to CLF ships. Even under the most generous option, the relatively small portion of funds allocated to CLF ships precludes rapid alterations in the composition of the fleet.

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1. The study used the 1987 level rather than the larger level of funding in 1988 that resulted from one-time appropriations for two aircraft carriers.

OPTION I: REDUCE PROCUREMENT

Option I assumes that in the face of limited total SCN funds, the Congress would want to restrict the share of funds available to CLF ships to protect funding for combat vessels and other required ships.

Specifically, Option I assumes that CLF ships receive the same 4 percent share of the SCN budget that they received on average between 1962 and 1988 (see Table 6). Coupled with no growth in total real SCN funding, a 4 percent share means that a total of $1.0 billion less would be available for CLF ships than was contained in the Administration plan. This reduction could be accommodated in several ways. One illustrative approach would result in the following reductions in ship procurements: two oilers (one in 1989 and one in 1991); one ammunition ship in 1991; and one fast combat support ship in

TABLE 6. EFFECTS OF CLF OPTIONS

	Percentage of SCN Budget Allocated to CLF 1989-1992	Number of CLF Ships		
		Purchased 1989-1992	Inventory in 1996 a/	Over Age 40 in 1996
Administration Plan	6	10	64	2
Option I (Reduce Procurement)	4	6	62	4
Option II (Eliminate Shortfall and Retire Older Ships)	8	13	65	0
Option III (Solve Problem of Fleet Replenishment Oilers)	9	14	68	2

SOURCE: Congressional Budget Office.

NOTE: SCN = Shipbuilding and Conversion, Navy Account; CLF = Combat Logistics Force.

a. The Navy goal for its 1996 CLF ship inventory is 65.

1991. These changes would mean buying a total of six CLF ships between 1989 and 1992, compared with 10 ships under the Administration plan. Annual funding associated with this option is shown in Table 7.

Option I attempts to offset these reduced procurements by delays in retirements, though with only limited success. Since actual Navy plans for retirements are not publicly available, this option assumes that CLF ships are retired when they reach 40 years of age unless they are needed to meet specific Navy requirements. But the option results in keeping only two more older ships--both oilers--compared with the Administration plan. Thus, the reductions in pro-curements under this option are not fully offset by delayed retirements (see Table 6).

Advantages and Disadvantages

Option I provides CLF ships with a lower percentage of funding than they receive under the Administration plan, but it is consistent with

TABLE 7. CLF FUNDS FOR NEW CONSTRUCTION UNDER ADMINISTRATION PLAN AND OPTIONS
(Budget authority in billions of 1989 dollars)

	1989	1990	1991	1992	Total
Administration Plan	0.7	0.3	1.4	0.3	2.7
Option I	0.5	0.3	0.4	0.4	1.7
Option II	0.7	0.7	1.5	0.6	3.5
Option III	0.7	1.1	1.3	1.1	4.1

SOURCE: Congressional Budget Office.

NOTES: Totals may not add because of rounding.

CLF = Combat Logistics Force.

historical policy, which allocated an average of 4 percent of SCN funds to CLF ships. It is also consistent with the Navy's approach to reducing ship budgets in the recent past (see Chapter III) when the Navy reduced the number of CLF ships proportionally more than the number of combat vessels. Finally, 4 percent of a constant SCN budget would provide roughly enough funds for the Navy to maintain its desired fleet of CLF ships in the long run (assuming retirement of older ships at 40 years of age and continuation of current real prices for ships).

This option would also hold down, though only by a modest amount, the reductions in funding for combat ships. To avoid any real growth above 1987 levels, SCN funds in 1989 through 1992 must be reduced by a total of about $2.4 billion below the Administration plan. If CLF ships receive 4 percent of the reduced total, then the non-CLF portion of the SCN budget must accommodate reductions of $1.4 billion. That reduction would be modestly larger--totaling $2.3 billion--if CLF ships received 6 percent of total funds, as they do under the Administration plan.

Despite these advantages, Option I operates two more oilers beyond 40 years of age, an action that is not ideal although it is not without precedent. Maintenance is more likely to be a problem with 40-year old ships, as equipment wears out and replacement parts are difficult to find. The Navy, however, has operated older oilers when necessary. For example, in 1987 the Navy operated seven oilers that were over 40 years old. Thus, while it may be less than optimal to operate older ships rather than to replace them with new ones, this remains a feasible option to meet the Navy's inventory objectives.

The greatest problem associated with delaying retirements may come in the 1990s. Ships now due for retirement would, if they continued in the fleet, be over 50 years old in 10 years' time. The Navy has less experience operating ships of that advanced age. Delaying retirements today may simply put off a problem until it becomes a much larger budget concern in the future, either because of costly maintenance and repairs or because of higher replacement costs.

In addition to putting off retirements, this option fails to meet the Navy's stated requirements by three ships (see Table 8): one fast

combat support ship and two ammunition ships. If the Navy eventually operates 15 aircraft carriers as it plans, then in a major war this option would not provide a station ship (fast combat support ship or fleet replenishment oiler) for each carrier. This could prevent the Navy from taking full advantage of its fleet of 15 carriers. There might also be shortages of ammunition ships to shuttle ammunition to the battle groups, particularly if--as was discussed in Chapter II--fleet commanders decide that ammunition ships must be diverted from shuttle duties to help deliver ammunition to battle group vessels. This shortage of fast combat support ships and ammunition ships could be less severe or even nonexistent if, in the process of reducing its budgets to meet new fiscal targets, the Navy decides not to increase its fleet to 15 deployable aircraft carriers. That goal, however, is one of the Navy's highest priorities and hence will not be readily sacrificed to accommodate the cuts.

In addition to failing to meet numerical requirements, this option does nothing to solve the problem of the large number of slower and

TABLE 8. PROJECTED CLF INVENTORIES IN 1996
(Number of ships)

	Fleet Replenishment Oilers	Fast Combat Support Ships	Oilers	Ammunition Ships	Stores Ships	Total
Navy Goal	a/	a/	24	16	10	65
Administration Plan	7	8	24	15	10	64
Option I	7	7	24	14	10	62
Option II	7	8	24	16	10	65
Option III	7	12	24	15	10	68

SOURCE: Department of the Navy data and Congressional Budget Office projections.

NOTE: CLF = Combat Logistics Force.

a. The Navy has a combined goal of 15 ships for fleet replenishment oilers and fast combat support ships. It does not establish separate goals for these types of ships.

less capable replenishment oilers that now must function as station ships. As already noted, this could mean diverting ammunition ships to augment the fleet replenishment oilers in their role as station ships. The replenishment oilers could also hamper operations in the battle group because they are significantly slower than other ships.

OPTION II: ELIMINATE SHORTFALL AND RETIRE OLDER SHIPS

Option II meets all of the numerical requirements set by the Navy with fewer older ships than the Administration plan. It demands more SCN funds for CLF ships, however, which could mean a modest reduction in the number of combat ships that would be purchased.

Specifically, Option II retires all CLF ships when they reach 40 years of age. This option also buys a total of 13 CLF ships from 1989 through 1992 compared with 10 ships under the Administration plan. The additional ships include one oiler shuttle ship in 1991 and two ammunition ships, one in 1990 and one in 1992. The greater number of new ships is sufficient to offset the retirement of all ships at 40 years of age; thus, the total number of CLF ships available in 1996 exceeds the number under the Administration plan and meets all Navy CLF requirements. But larger purchases also increase total costs of CLF ships by $0.7 billion above the level under the Administration plan. This increase causes CLF funding to rise to an average of 8 percent per year of an SCN budget that is assumed to remain constant in real terms. This amount would be significantly larger than the historical level of 4 percent assumed in Option I and also larger than the 6 percent assumed in the Administration plan.

Advantages and Disadvantages

In contrast to Option I, this approach meets all the numerical requirements set by the Navy. Moreover, it does so while maintaining a reasonably modern CLF fleet--one that has no ships that are more than 40 years of age. Thus, unlike Option I and to a lesser extent the Administration plan, this option does not put off until the 1990s the

problem of buying enough CLF vessels to avoid having old and possibly unreliable ships in the fleet.

The benefits of this option, however, come at a cost that might include a modest reduction in the number of combat ships that could be purchased. CLF costs under this option exceed those under the Administration plan by $0.7 billion over the next four years. Table 9 shows the unit costs of combat vessels that the Administration plans to buy over the 1989-1992 period. The added CLF costs under Option II could be offset by only a small reduction in the number of combat ships purchased under the Administration plan. For example, the added costs of this option relative to those in the Administration plan could be offset, in approximate terms, by any one of the following reductions: one fewer SSN-688 Los Angeles class nuclear attack submarine, one fewer DDG-51 Arleigh Burke class guided missile destroyer, or one fewer LHD-1 Wasp class amphibious assault ship. This study does not attempt to analyze the effects of such reductions on the capability of the fleet; it simply notes that they are modest.

TABLE 9. COST OF COMBAT SHIPS PURCHASED UNDER ADMINISTRATION PLAN

Ship Type	Average Unit Cost (In billions of 1989 dollars)
SSN-688 Los Angeles Class Nuclear Attack Submarine	0.7
SSN-21 Seawolf Class Nuclear Attack Submarine	1.2
DDG-51 Arleigh Burke Class Guided Missile Destroyer	0.8
LHD-1 Wasp Class Amphibious Assault Ship	0.9
LSD-41 Whidbey Island Class Dock Landing Ship (Cargo Variant)	0.3

SOURCE: Congressional Budget Office based on Department of the Navy data.

On the other hand, any reductions in combat ships to offset greater costs of CLF ships might be in addition to cuts necessary to meet revised budget targets. In order to achieve zero real growth in SCN funds above 1987 levels, the Administration shipbuilding plan would have to be reduced by $2.4 billion from 1989 through 1992. If they receive a proportional share of the cuts, combat ships of the types listed in Table 9 would have their funding reduced by $1.6 billion. Substantial reductions in the number of combat ships could be required to achieve zero real growth. In that context, the need for further cuts under this option to fund greater spending for more CLF ships could constitute a major disadvantage.

Moreover, despite added funding, this option does not move toward meeting the larger numbers of ships needed under the alternative view of requirements discussed in Chapter II. And this option still does not correct the problem of slower, less capable fleet replenishment oilers that could restrict the capabilities of the battle groups they serve.

OPTION III: SOLVE PROBLEM OF FLEET REPLENISHMENT OILERS

Option III attempts to meet the most serious deficiency in CLF capability identified by the alternative view of requirements: the lack of large station ships that are fast enough to keep up with battle groups operating at top speed. Specifically, this option buys all the ships in the Administration plan plus four of the large fast combat support station ships (two in 1990 and two in 1992). In addition, the option retains currently operating ships in the fleet even if they reach 40 years of age when they are needed to meet force goals. As a result, the additional four fast combat support ships increase the 1996 inventory and allow this option to exceed Navy numerical requirements for CLF ships by at least three ships.

Advantages and Disadvantages

The key disadvantage of this option is its cost. At a cost per ship of about $0.4 billion, the fast combat support ships are the most

expensive of the CLF ships. Adding four of them to the Administration plan causes CLF ships to consume 9 percent of the total SCN budget if, as is assumed in this study, that total budget remains constant in real terms. The Navy could be required to reduce purchases of combat ships as an offset. The reductions relative to the Administration plan would still be modest--probably two to four ships depending on the type of combat ships selected--but even these modest reductions could be difficult to sustain if the number of combat ships in the Administration plan has already been reduced to meet lower budget targets.

Nor does this option move significantly toward meeting the numerical requirements under the alternative view. That alternative view called for up to 93 CLF ships; this option would provide only 68 ships by 1996. Relative to the alternative view of requirements, the Navy under this option would still not have enough shuttle ships to ferry supplies to battleships and Marine transport ships while also supplying its carrier battle groups. This would be the same situation as under current Navy planning, but could hamper battleship or Marine amphibious operations if they occur simultaneously with those of aircraft carrier battle groups.

The addition of four fast combat support ships would result in an inventory of 19 station ships, of which 12 would be fast combat support ships. For the purposes of planning force levels, these new fast combat support ships would replace four of the less capable fleet replenishment oilers in their role as station ships dedicated to aircraft carrier battle groups. As a result, four aircraft carrier battle groups would be made more capable. Because the new fast combat support ships would be able to operate at 26 knots, compared with 20 knots for the fleet replenishment oilers, the four carrier battle groups would be able to travel more quickly, thereby increasing their tactical abilities.

Moreover, because fast combat support ships have a greater storage capacity for ammunition, battle group commanders would no longer need to consider having an ammunition ship team up with one station ship in the four affected aircraft carrier battle groups. In addition to providing a more robust station ship force, therefore, adding four fast combat support ships to the fleet would guarantee that four more ammunition ships would be able to perform their

planned role as shuttle ships. There would, however, still be three battle groups served by the slower fleet replenishment oilers.

Finally, the four fleet replenishment oilers that were removed from serving aircraft carrier battle groups could be allocated to serve as station ships for the four battleship groups or to increase the capability of the oiler shuttle force. Current Navy planning does not allocate any CLF ships to the battleship groups. The capacity of the battleship groups to sustain operations would be increased by allocating fleet replenishment oilers to these forces.

CHOICES FACING THE CONGRESS

If faced with limits on total SCN funding, the Congress can take several approaches to funding the fleet of CLF ships. If it wishes to limit the share of funds for CLF ships, in order to maximize funds for combat ships or other shipbuilding needs, then it could delay retirements to offset adverse effects on the number of vessels (Option I). If a larger share of funds can be devoted to CLF ships through modest reductions in the number of combat ships, then the Congress can choose to move toward either a newer CLF fleet (Option II) or a slightly larger one that eliminates one of the most serious current deficiencies--the shortage of fast station ships that can keep up with carrier battle groups (Option III).

Deciding whether to allocate a larger share of funds to CLF ships depends on a judgment that this study can identify but not resolve. The Navy could elect to buy slightly fewer combat ships in order to minimize the risk that those combat ships would not be fully supported in a war. Or it could maximize the number of combat ships and hope that merchant ships, other vessels, or altered tactics can meet wartime logistics needs or that the scale and intensity of a future conflict would not demand simultaneous widely dispersed operations.

APPENDIX

UNDERWAY REPLENISHMENT OF VERTICAL LAUNCH SYSTEMS

The ability of cruisers and destroyers to perform their wartime mission of protecting ships in aircraft carrier battle groups and battleship surface action groups is critically dependent on using guided missiles to attack enemy airplanes, cruise missiles, and submarines.1/ Replenishing cruisers and destroyers at sea with guided missiles can be a problem because of the way these missiles are stowed and launched. This problem could affect requirements for the Combat Logistics Force (CLF) as well as the cost of providing an adequate CLF.

New cruisers and destroyers and 24 Spruance class destroyers already in the fleet will be equipped with the Mk-41 Vertical Launch System (VLS).2/ This system stores missiles vertically in canisters that are arranged in modules of eight canisters (or "cells") each. Several groups of launch modules are assembled and fitted into ships' decks, and electronic fire control systems complete the VLS. Standard surface-to-air missiles, Tomahawk cruise missiles, and anti-submarine rockets are fired directly from their canisters in the VLS.3/ During replenishment operations, empty canisters must be removed by a crane which is housed in the VLS, and loaded canisters must be inserted in their place.

Underway replenishment of the VLS is slow. Although the rate at which a combat ship can be resupplied with missiles depends on the proficiency of its crew, the weather, and the roughness of the sea, under generally satisfactory environmental conditions about three or

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1. Cruisers and destroyers are also capable of providing gunfire support for Marine Corps forces fighting on the shore and attacking targets on land with cruise missiles.

2. The first five cruisers of the CG-47 Ticonderoga class are not fitted with the Mk-41 VLS. The USS Bunker Hill (CG-52) and subsequent Aegis cruisers will have the VLS. All DDG-51 Arleigh Burke class destroyers will have the VLS.

3. The "vertically-launched" version of the anti-submarine rocket (ASROC) is currently under development and will enter the fleet in the early 1990s.

four canisters (or missiles) can be replaced per hour.4/ Replenishing each of the front-line cruisers and destroyers of the 1990s would require that supply ships steam alongside combat ships for extended periods (see Table A-1). Each of these ships would be unable to fight while being resupplied with missiles.

Combat ships could fire a substantial proportion of their missile capacity in one encounter with Soviet forces in an intensive battle, such as one which could take place in the Norwegian Sea. If Soviet forces attack in waves, as some military analysts assume, then the resupply times suggested in Table A-1 would severely limit the ability of combat ships to rearm completely between attacks.5/ This limitation could leave the ships without an adequate load of guided missiles to defend themselves, the aircraft carrier or battleship, and the rest of the battle group.

If escort vessels cannot be resupplied in a timely fashion, then battle group commanders must make difficult decisions. They could be forced to withdraw certain ships, or perhaps the entire battle group, from the fighting and send them into port for resupply. If ships are not resupplied, they could be kept in the battle, albeit with a diminished load of missiles. Alternatively, replenishment could be limited to a standard operational replenishment time (three to five hours) and result in significantly fewer missiles aboard these ships.6/

Some analysts have recommended that the Navy reduce, or perhaps eliminate, the need for underway replenishment of guided missiles for cruisers and destroyers by modifying missiles and the

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4. For a thorough discussion of underway replenishment for the VLS, see Paul W. Stiles, "An Alternative to VLS UnRep" in U.S. Naval Institute, *Proceedings*, vol. 113/12/1018 (December 1987), pp. 129-131. The replenishment rates cited are drawn from this article.

5. Loading canisters into the VLS limits the rate at which missiles can be resupplied. Alongside time could be reduced by stacking canisters on the decks of combat ships, and placing them into the VLS after the CLF ship has departed. However, space constraints on combat ships allow only a limited number of missiles to be stacked, resulting in a small reduction in alongside time.

6. It does not appear likely that modifications to the VLS itself could greatly accelerate the replenishment process. While the Navy is considering a number of ideas for improving replenishment time for the VLS, the rate improves to only six missiles per hour under the best of these alternatives. (See Stiles, "An Alternative to VLS UnRep.") Although this is a 50 percent improvement over current capabilities, it still means that full replenishment of all missiles for a cruiser, for example, would take 20.3 hours, or about four times longer than standard replenishment.

TABLE A-1. ESTIMATED ALONGSIDE TIMES FOR REPLENISHMENT

Ship Type	VLS Missile Capacity (Number of missiles)	Rate of Resupply (Missiles per hour)	Alongside Time for Full Missile Replenishment (In hours)
CG-47 Ticonderoga Class Cruisers	122	3.5	34.9
DDG-51 Arleigh Burke Class Guided Missile Destroyers	90	3.5	25.7
DD-963 Spruance Class Destroyers	61	3.5	17.4

SOURCE: Congressional Budget Office.

NOTE: VLS = Vertical launch system.

shipboard radars, communications systems, and sensors that guide missiles to their targets.7/ Rather than replenishing each combat ship, it is argued, the Navy could modify existing systems so that the most capable cruisers and destroyers (those equipped with Aegis weapons systems) could employ their electronic capabilities to guide missiles fired from ships with less sophisticated electronics. Analysts have proposed putting the VLS on barges, on fleet replenishment oilers and fast combat support ships, and on other combat ships. Missiles fired from these ships could be guided by Aegis-equipped ships. The increases in firepower gained in this manner, it is argued, would offset the need for underway replenishment of missiles. Current missiles and electronic systems do not allow one ship to guide missiles fired from another, although the Navy is considering developing such a capability.

7. See Stiles, "An Alternative to VLS UnRep"; and Scott C. Truver, "Improving Navy Surface Warfare Capabilities: A Near-Term Solution," *Armed Forces Journal International* (November 1987), p. 50.

What implications does slow underway replenishment for the VLS have for the CLF? On the one hand, it can be argued that the slow replenishment rates for the VLS are not a very significant change for the Navy. The rearming rate for the VLS at sea may not be appreciably different than the rates for existing missile systems and classes of ships, and therefore the VLS may not create new resupply problems. Moreover, in the heat of battle, it may not make a difference whether guided missiles can be resupplied at a rate of three per hour or at some higher feasible rate. The tempo of the battle and the finite weapons capacity of current classes of cruisers and destroyers could mean that replenishment vessels could not resupply combat ships quickly enough in any intense naval conflict. (Acceptance of this line of reasoning is a strong argument for developing the capability to guide missiles launched from other vessels, as discussed above.) Since the Navy has never had to transfer large numbers of missiles at sea during wartime conditions, there is no historical evidence to help decisionmakers evaluate these issues.

On the other hand, slow underway replenishment could have important effects for the CLF, since that may mean that the requirement for ammunition ships is further understated. Because the time it takes to unload ammunition is considered in the Navy's calculation of its force level requirements, the long replenishment times for the VLS could mean that several more ammunition ships would be required to support wartime operations. In addition, costs for fast combat support ships proposed in the 1989 budget would probably increase if a VLS is added to the ship's design.

In sum, the slow replenishment of the VLS could have an impact on the Navy's future budgets. The impact could result from the development costs for modifying existing electronic systems and missiles to enable some ships to guide missiles fired from other ships, or from developments to improve modestly the capabilities of the current Mk-41 VLS (that is, upgrading the system to allow it to improve rearming rates to around six missiles per hour), or from adding the VLS to ships other than those currently envisioned by Navy planners. The precise impact depends on choices that the Navy and the Congress will make in the coming years.

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